NISHNABOTNA RIVER BRIDGE
Iowa Bridges Recording Project
Spanning Nishnabotna River at county road
Manilla Vicinity
Crawford County
Iowa

HAER No. IA-48

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Location:	County road over the Nishnabotna River; 2.3 miles southwest of Manilla, Crawford County, Iowa UTM: 15.311886.4637260 USGS: Defiance, Iowa quadrangle (7.5 minute series, 1971)
Date of Construction:	1945
Designer/ Fabricator:	Des Moines Steel Company, Des Moines, IA
Contractor:	County work force
Owner:	Crawford County
Present Use:	Roadway bridge
Significance:	The availability of steel for domestic purposes like bridge building was severely limited during World War II. Most of the counties of Iowa, including Crawford County, turned to timber to fulfill their short-span bridge construction needs. In May of 1945, however, heavy flooding washed out 27 bridges and culverts throughout the county. It was decided to build replacement spans using steel. The Des Moines Steel Company was hired to design and fabricate the bridges. Forced to economize with material they turned to a bridge form that was popular in the 1860s and 1870s: the bowstring arch-truss. Although lacking the lateral stability of later bridge forms, the bowstring offered outstanding structural efficiency. During the period of the 1860s and 1870s thousands of bowstring arch-trusses were built throughout the nation. In a time of national crisis this once popular bridge form again supplied the solution. The Nishnabotna bridge is an excellent example of this series of bridges built during the war.

Historian: Geoffrey H. Goldberg, engineer, August, 1995

Project Information: This document was prepared as part of the Iowa Historic Bridges Recording Project performed during the summer of 1995 by the Historic American Engineering Record (HAER). The project was sponsored by the Iowa Department of Transportation (IDOT). Preliminary research on this bridge was performed by Clayton B. Fraser of Fraserdesign, Loveland, CO.

The month of April 1945 was a devastating time for Crawford County, Iowa. It seemed the rain would never end. The first 23 days of the month saw 6.86 inches of rainfall - more than had been recorded for any previous April.[1] The Boyer River, which runs from the northeast to southwest corners of the county, had become engorged, fed by waters rushing down from the saturated slopes of the county's many rolling hills. The valley at the confluence of the east and west branches of the Boyer, just to the West of the county seat, Denison, had become a lake one mile across. Many had to vacate their homes.

Highways throughout the county were impassable. Many were covered by earth washed down from the unstable slopes. Others were washed out from the raging water. It was not until two weeks after the deluge subsided that the full extent of the damage was known. Thirty miles of the county's highways had been rendered impassable because of washouts and bridge losses.[2] The County Supervisors reported that 27 bridges "were washed out or collapsed, or had the approaches washed away."[3]

On the seventh of May, the County Supervisors issued a declaration that "an emergency exists with regard to the Secondary Road Construction and Maintenance funds of (the county)

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[1]"Rampaging Boyer Drowns Valleys," *Denison (Iowa) Review*, 26 April 1945. The greatest amount recorded for any previous April was 6.79 inches in 1896.

[2]"28 Bridges Washed Out by Flood," *Denison (Iowa) Review*, 10 May 1945.

[3]Crawford County Board of Supervisors' Minutes, Book T: pages 175-176 (7 May 1945), Crawford County Courthouse, Denison, IA.

...and that said emergency warrants, and makes a necessity of spending more money for the maintenance and repair ...(than) has been received from taxation sources for this fund during the current year."[4] With this declaration, the Board was authorized by state law to arrange for funds to cover the emergency by issuing bonds.

This was the third time in as many years that the county had to issue bonds to cover emergency bridge repairs; in the previous year alone, the county issued almost a quarter million dollars of emergency warrants.[5] Many Crawford County citizens were alarmed at these expenditures. Suggestions were made to undertake soil conservation measures, such as terracing, to keep the water on the hills. The county's newspaper, the *Denison Review*, was a strong advocate of the proposed measures claiming that the "county can not afford to issue a quarter of a million dollars in bonds every year to keep her highways and bridges in usable condition."[6]

Whatever was done, it was deemed essential that the bridge replacements be enduring, ruling out timber bridges. It was decided that the bridges most at risk be built of steel. This presented a problem, however, because of the severe war-time restrictions on the civilian use of steel.

During the Second World War, the United States adopted a fully command economy. The availability of virtually all manufactured products, from bath tubs to bobby pins, even bread, was tightly controlled. Soon after the bombing of Pearl Harbor, the War Production Board (WPB) was established to ensure an adequate supply of matériel to fight the war. Raw materials necessary for the manufacturing of civilian goods were allocated by the WPB based upon estimates from the Office of Civilian Requirements (OCR) which acted on behalf of the manufacturers of products for civilian markets. The three basic metals: steel, copper, and aluminum, so necessary for the prosecution of the war, were tightly regulated. On May 4, 1942 the WPB issued an order completely shutting down the use of steel for the manufacturing of more than 400 civilian products, including bath tubs, bird

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[4]Board of Supervisors' Minutes

[5]"28 Bridges Washed Out by Flood," *Denison (Iowa) Review*, (10 May 1945)."

[6]"28 Bridges Washed Out by Flood," *Denison (Iowa) Review*, (10 May 1945)."

cages, flashlight tubes, chairs, gutters, and culverts.[7] The controls were later expanded to include 646 items.

The regulation of the production of steel was total. The War Production Board reviewed and approved the production schedules of mills to ensure an adequate supply of shell steel, structural steel, bars, tubing, and plates. The WPB instituted a Production Requirements Plan (PRP), effective July 1, 1942, which required every manufacturer who used "a significant quantity of material" to submit quarterly estimates of their material needs along with the priority ratings[8] of their orders. The Board would total the material requirements, compare them to the available supplies, and then scale down the requirements to match. Business and industry recognized the importance of these tight controls, feeling that:

> The United States could fight-and maybe win-a major war without a workable system of material control, (but) the problem of maintaining tight control over the flow of materials is a critical one because the difference between the peak output that will be attained under incomplete planning and the peak theoretically possible may well prove to be the margin of victory.[9]

To fine-tune the supply of steel, the Board instituted a "share-the-steel" campaign in July of 1943 when it was apparent that there was a deficit of some 1,000,000 tons in the steel supply for the third quarter of that year.[10] Consumers of steel were urged to cancel orders for steel products if they had large inventories of the items relative to their current consumption. In this way, it was argued, the availability of steel would be smoothed out.

The need for raw steel was acute. All possible sources for the material were explored. The Army developed a plan to construct

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[7]"Steel Shutdown: New WPB Order Will Halt Civilian Output for Duration," *Newsweek* 19, no.19 (11 May 11 1942): 57.

[8]All contracts for manufactured goods had priority ratings - the highest (AAA) being those items required for military emergency purchases.

[9]"Scheduled Output," *Business Week*, (22 August 1942): 19.

[10]"Share-Steel Drive Nets 150,000 Tons," *New York Times*, 17 July 1943, p.17, col.3.

the bodies of their larger transport trucks out of wood.[11] Citizens were urged to junk their old cars with the hope that: "with the patriotic cooperation of the owners of cars and of auto graveyards, ... (we) should see some 500,000 jalopies a month converted into airplanes, tanks, and ships."[12] The situation was so desperate that WPA laborers were used to dig up the streets, in effect mining them, for old trolley rails buried beneath the asphalt and concrete.

In January 1944, the WPB's Steel Division recommended revocation of the severe steel conservation orders. However, the Army and Navy favored keeping the measures, so the Board kept them in full effect.[13] Following V-E Day (May 8, 1945), WPB began gradually relaxing its wartime industrial controls. On May 10, J.A. Krug, the chairman of the WPB, announced that 73 prohibition orders were revoked immediately and about half of the 420 orders then in effect would be removed "within the next few months."[14] He gave July 1, as the date on which business will have unrestricted access to steel, copper, and aluminum. However, it would take many months for supplies to be considered free.

In December 1942 a subcommittee of the Engineers' Defense Board, all of whom were members of the American Society of Civil Engineers (ASCE), made recommendations on the conservation of steel in response to a request from the government. The recommendations were published in ASCE's magazine, *Civil Engineering*, in February 1942. Among their suggestions was the need to "discourage, and in some cases, prohibit the use of steel for the construction of items where less critical materials...can be used instead" and that in designing bridges "the most careful

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[11]"Army Trucks to Save Steel," *New York Times,* 1 July 1942, p.20, col.2. It was estimated that 275,000 tons of steel a year could be saved by constructing the bodies of 1½ ton and larger transport trucks out of wood instead of steel.

[12]"Jalopies are Invited to 'Commit Suicide': WPB Urges Junking of Old Cars for War Purposes," *New York Times,* 29 May 1942, p.10, col.2.

[13]"WPB Bars Resuming Civilian Production," *New York Times,* 14 January 1944, p.27, col.7.

[14]"73 WPB Controls Revoked by Krug; Metals to be Freed," *New York Times,* 11 May 1945, p.1, col.3.

economic studies be made in order to reduce the weight of steel to a minimum."[15]

This prescription immediately suggests the use of the bowstring arch -- a bridge form that was popular in the 1860s and 1870s precisely because of the intrinsic efficiency of the design.[16] A contract was let to the Pittsburgh-Des Moines Steel Company of Des Moines for six steel bridges. Now, in a time of crisis, the designers again turned to the once familiar bowstring form.

The Pittsburgh-Des Moines Steel Company grew out of an operation formed in 1892 when two young graduates of Iowa State College, William H. Jackson and B.N. Moss, formed a partnership to build municipal water works including steel water towers.[17] Initially, they had their steel tanks fabricated by the Keystone Bridge Company in Pittsburgh, Pennsylvania. Because the cost of transporting the tanks from Pittsburgh was so high, Jackson and Moss took on a third partner, E.W. Crellin, the owner of a small steel fabricating plant in Des Moines. The company they created, the Des Moines Bridge and Iron Company, would sell and erect the structures, and an additional firm they created, the Des Moines Bridge and Iron Works, would ship the steel stock from Pittsburgh and perform the fabrication. The company manufactured a wide range of steel structures including water tanks and water works, bridges, and electric lighting plants.

By 1910 the company had built a plant and new headquarters in Pittsburgh, near their steel suppliers. In 1916 the partners changed the company's name to Pittsburgh-Des Moines Steel Company. Moss left the company around 1905. Crellin was president until 1923, when Jackson bought out his interest and became president. The partnership was dissolved in 1956 and the corporation took on the name Pittsburgh-Des Moines Steel Company. The company continues in operation to this day.

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[15]"Recommendations on Conservation of Steel," *Civil Engineering* 12, no.2 (February 1942): 119-120.

[16]Geoffrey H. Goldberg, "Fremont Mill Bridge," Historic American Engineering Record report IA-58, August 1995, gives an account of one of the many bowstrings built in Iowa during this period.

[17] Orin L. Dahl, "Pittsburgh-Des Moines Steel Company," in *Des Moines: Capital City*. Tulsa: Continental Heritage, Inc., 1978. 227. Much of the history of the company presented here is taken from this source.

The Nishnabotna River Bridge, a 77' span pony truss, is typical of the bowstrings that the Des Moines Steel Company built for the county. The upper chords, forming the arches, are constructed of double angles. The lower chord as well as the verticals are also built from double angles. The diagonal members, fabricated from single angles, are riveted together where they cross. Gusset plates are used to attach the vertical and diagonal members to the chords via rivets. Lateral stability was provided by double angle outriders which run from the ends of the I-section floor beams, extending beyond the vertical plane of the trusses, to the upper chords. The substructure of the bridge consists of driven piles with timber backwalls. The bridges were erected by county work-crews. Each truss was shop fabricated in two halves. The two halves were later assembled in the field by the work-crews.

Most of these bridges continue in service today. In 1986 the bridge at Paradise, seven miles west of Denison was removed. After the centers of the floor beams had been cut out to make the bridge narrower, it was relocated to the county's Yellow Smoke Park where it serves to carry a pedestrian path. The bridges serve as a rare example of small span steel bridges built during the Second World War.

SOURCES CONSULTED

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ADDENDUM TO
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This appendix is an addendum to a 9-page report previously transmitted to the Library of Congress.

APPENDIX: ADDITIONAL REFERENCES

Interested readers may consult the Historical Overview of Iowa Bridges, HAER No. IA-88: "This historical overview of bridges in Iowa was prepared as part of Iowa Historic Bridges Recording Project - I and II, conducted during the summers of 1995 and 1996 by the Historic American Engineering Record (HAER). The purpose of the overview was to provide a unified historical context for the bridges involved in the recording projects."